


# The COVID-19 lockdown increased obesity disparities; Will the increases in type 2 diabetes continue?

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## Abstract

**Objective:** The aim of this study was to compare the prevalence of the increases in pediatric obesity during the COVID-19 lockdown with the annual increases in obesity in the National Health and Nutrition Examination Survey (NHANES).

**Methods:** This study compared two reports of increases in the prevalence of obesity in youth during the COVID-19 lockdown with the annual rate of increase in obesity in NHANES.

**Results:** When expressed as multiples, the changes in prevalence among elementary school children observed in two population-based surveys were 28 to 63 times greater than the annual changes in the prevalence of obesity observed in NHANES. Increases in Black and Hispanic youth were greater than those in White youth. The net impact of the COVID-19 lockdown increased the disparities in obesity among this age group.

**Conclusions:** The rapid increases in obesity are likely to persist and may be associated with an increase in the prevalence of severe obesity as these children age. Furthermore, the increased susceptibility to diabetes in Hispanic and Black children, as well as the reported increase in diabetes among 0- to 18-year-old individuals during the COVID-19 pandemic, may lead to an increased incidence of type 2 diabetes in minority youth with obesity.

## INTRODUCTION

Consequent to the lockdown in response to the SARS-CoV-2 pandemic, usual practices related to diet and physical activity were suddenly disrupted. Studies of children and adolescents in the United States [1–5] have indicated marked increases in the prevalence of obesity in response to these disruptions. The general approach used in these studies, which we will call field studies, was to estimate the prevalence of obesity in longitudinal cohorts in which heights and weights were measured for some period of time prior to the pandemic and to compare the pre-pandemic prevalence of obesity with the prevalence of obesity in the same individuals assessed for various periods of time during the pandemic lockdown. Reported changes in the prevalence of obesity ranged from 1% to 7% [1, 2] among 2- to 20-year-old individuals over 6 to 10 months [1, 2], depending on the subgroup sampled. However,

because the time periods during which data were collected during the pandemic were variable, and the populations were diverse, it is difficult to appreciate and compare the magnitude of the increases in prevalence, as well as the striking disparities in the changes in the prevalence of obesity in Black and Hispanic populations. This study attempts to address this problem by comparing the reported increase in prevalence of obesity in the field studies conducted during the pandemic with the annual increase in the prevalence of obesity estimated from data reported by the National Health and Nutrition Examination Survey (NHANES) [6]. However, because several of the field studies did not include changes in the prevalence of obesity by ethnicity [3–5], comparisons with the NHANES data were limited to two studies [1, 2]. Furthermore, because the NHANES analyses did not include gender, comparisons of changes in prevalence were limited to age groups that combined both genders.

## METHODS

To begin, the reported prevalence of obesity in the field studies was annualized to calculate annual estimates of the change in prevalence. The study by Woolford et al. [1] reported prevalence data collected over a 10-month period (March 2020 through January 2021) using electronic health records of 5- to 17-year-old children and adolescents enrolled in Kaiser Permanente Southern California. Wu et al. [2] reported prevalence data collected over a 6-month period (July through December 2020) using electronic health record data from 2- to 17-year-old children and adolescents enrolled in three practice groups in Massachusetts. To convert the disparate data collection periods to an annual rate, the prevalence data were multiplied by 1.2 [1] and 2 [2], respectively. Because the NHANES data from 1999 to 2018 were reported as biennial changes in prevalence [6], the biennial changes were divided by 2. To calculate the changes in prevalence as a multiple of the annual expected changes, the annualized changes in prevalence reported in the field studies were divided by the annual changes in prevalence reported by NHANES. When the age groups did not match those provided by the NHANES data, the closest matched age group was used. For example, Woolford et al. [1] grouped their data in 5- to 11-year-old and 12- to 15-year-old age groups; here their reported changes in prevalence were compared with the NHANES changes in 6- to 11-year-old and 12- to 19-year-old individuals. Wu et al. [2] included 12- to 20-year-old individuals; here their results were compared with 12- to 19-year-old individuals in NHANES. In addition, Wu et al. included a Hispanic group; here their data on Hispanic individuals were compared with the NHANES data for Mexican American individuals. Because the annual changes in 2- to 5-year-old Black children in NHANES were level after 2005 to 2006, and the changes in 2- to 5-year-old White children were negative, 2- to 5-year-old children were excluded from these analyses.

## RESULTS

The characteristics of the field study samples and the calculated prevalence in excess of the NHANES annual increases are shown in Table 1. The changes in the prevalence of obesity among 5- to 11-year-old children ranged from 28 to 63 times the annual increase found in NHANES, and the most dramatic differences were observed among 5- to 11-year-old Black and Hispanic children. In contrast, only fivefold increases occurred in 12- to 20-year-old individuals.

## DISCUSSION

Although the reported increases in the prevalence of obesity observed in the field studies were expressed in absolute terms, the increases are even more shocking when compared with the annual expected increases derived from NHANES. An equally grave concern is that several of the field studies reported increases in prevalence that were greater among children and adolescents who already had

### Study Importance

#### What is already known?

- Although rapid increases in the prevalence of childhood obesity occurred during the COVID-19 lockdown, the magnitude of weight changes has not been compared with the expected annual changes in prevalence.

#### What does this study add?

- The changes in prevalence among elementary school children were 16 to 63 times greater than the annual changes in prevalence based on the National Health and Nutrition Examination Survey.

#### How might these results change the direction of research or the focus of clinical practice?

- The massive increases in prevalence suggest that severe obesity will increase as these children grow older.
- The increase in the prevalence of obesity coupled with the observed pandemic increase of diabetes in youth suggests that we may also face a new pandemic of diabetes in Black and Hispanic adolescents.
- Awareness of these complications should prompt both clinical interventions and routine screening for diabetes among preadolescents and adolescents.

overweight or obesity [1, 3, 4]. This observation suggests that the pandemic lockdown was not only associated with dramatic increases in the prevalence of obesity, but also that the prevalence of severe obesity may have increased in children aged 6 to 11 years [4].

Few studies have examined the effects of the COVID-19 lockdown on diet and physical activity levels in children and adolescents during the pandemic. Factors leading to the disproportionate increases of obesity in 6- to 11-year-old children may be similar to those that increase the prevalence of obesity during the summer school vacation, which also disproportionately increases obesity in Black and Hispanic children and children with overweight [7]. The absence of school meals may have increased reliance on ultraprocessed foods, which have been associated with obesity [8]. Physical activity declined during the pandemic [9] and screen time increased, with greater increases among 12- to 13-year-old Black and Hispanic children [10]. Why the comparative increases in the prevalence of obesity among children substantially exceeded that in adolescents remains unexplained. Perhaps 12- to 19-year-old individuals may have been less dependent on schools for physical activity, and they may have been more resourceful in maintaining a healthful food pattern.

The long-term adverse impacts of the rapid increases in obesity in youth may be catastrophic. Increases in the prevalence of severe obesity are likely to persist and increase the likelihood of the development

**TABLE 1** Rates of increase in the prevalence of obesity in field studies compared with the expected annual increase in the prevalence of obesity from NHANES [6]

Reference	n	Race/ethnicity	Group	Annualized prevalence change	Annual change NHANES	Increase in excess of NHANES
Woolford et al. [1]	191,509	50% Hispanic, 25% non-Hispanic White, 10% Asian/Pacific Islander	5–11 yo	7.4%	0.2% <sup>a</sup>	37×
			12–15 yo	5.6%	0.35% <sup>a</sup>	16×
Wu et al. [2]	46,151	54% White, 10% Black, 13% Hispanic, 9% Asian, 15% unknown	All 6–11 yo	5.6%	0.2%	28×
			6–11 yo Whites	3.0%	0.05%	60×
			6–11 yo Blacks	12.6%	0.2%	63×
			6–11 yo Hispanic	14.2%	0.35% <sup>b</sup>	40×
			All 12–20 yo	2.4%	0.35%	7×
			12–20 yo Whites	1.8%	0.2%	9×
			12–20 yo Blacks	5.0%	0.35%	14×
			12–20 yo Hispanic	4.8%	0.55% <sup>b</sup>	9×

Abbreviation: NHANES, National Health and Nutrition Examination Survey.

<sup>a</sup>Based on prevalence estimates for 5- to 11-year-old and 12- to 19-year-old individuals reported by Ogden et al. [6].

<sup>b</sup>Based on estimates of annual prevalence changes for Mexican American individuals in Ogden et al. [6].


of serious comorbidities. Diabetes is one of the most likely consequences of the increases in prevalence during the pandemic. Rates of prediabetes were increasing in 12- to 19-year-old youth prior to the pandemic [11], and the prevalence of prediabetes was greater among 12- to 19-year-old Black and Hispanic individuals in the 2015 to 2018 NHANES cycles [11]. Several studies have demonstrated marked increases in type 2 diabetes (T2DM) among adolescents during the pandemic that ranged from 77% to 293%, with greater increases in Black and Hispanic youth compared with White youth [12–14]. Severe obesity was already present in many of those who developed T2DM [13, 14]. In the only study, to our knowledge, that examined weight gain immediately prior to diagnosis, weight increased by a median of 11 kg (interquartile range: 6.1–17.7 kg) [14]. The recognized increased risk of diabetes among 12- to 19-year-old Black and Hispanic adolescents compared with White adolescents [15], the increased risk of multiple complications associated with diabetes in Black and Hispanic adolescents and young adults [16], the marked increases in the prevalence of obesity during the COVID-19 lockdown, and the increased risk of diabetes during the pandemic heighten the concern that a subsequent increase of T2DM will follow the COVID-19 pandemic and disproportionately affect Black and Hispanic children who had excessive weight gain during the COVID-19 lockdown.

This analysis includes several limitations. Both of the studies used in these comparisons were local or regional, were different from each other, and do not reflect the demography of the United States. Therefore, our findings may not be generalizable to the US population. The accuracy of the estimates of obesity in the field studies depends on the quality of the body mass index (BMI) measurements used to calculate the prevalence of obesity, and there is no way to assure that these measurements were accurate and no way to assess how measurement error would affect these results. Furthermore, there may

have been significant differences between those children and adolescents seen during the pandemic compared with those measured before the pandemic. Although the Woolford et al. study encompassed almost a full year, the prevalence increases in the Wu et al. study may have been disproportionately increased by the influence of the summer months. However, the rates of excessive weight gain during the summer months among kindergarten children in the United States have amounted to 2% to 6% changes in BMI percentiles [17] or 0.24 BMI units [18], well below the rates of increased weight gains observed in the Woolford et al. and Wu et al. studies. Comparisons of the prevalence of obesity in age groups that were younger than those in NHANES may have also introduced an error in the estimates; however, because obesity in childhood and adolescence increases with age, these differences would likely underestimate the impact of the annual NHANES prevalence changes on obesity. The reported prevalence of obesity in Mexican American children is 1% to 2% greater than in Hispanic children [19], which could have overestimated the differences that we observed. Although these weaknesses may have affected the precision of our estimates, they are not likely to significantly change the magnitude of the changes observed.

## CONCLUSION

The rate of increase in obesity among 6- to 11-year-old children during the COVID-19 pandemic, especially among Black and Hispanic youth, was many multiples in excess of the annual increase expected based on NHANES data. Because increases in weight gain were greater among children who already had overweight or obesity, it is likely that severe obesity in these groups has also increased. Rates of T2DM increased markedly among adolescents during the pandemic. If

the increases in obesity among 6- to 11-year-old children are generalizable and sustained into adolescence, an even more rapid increase in the prevalence of T2DM among Black and Hispanic adolescents could occur. 

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## CONFLICT OF INTEREST

The author declared no conflict of interest.

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